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54 Bone rasp.

57) A rasp (10) adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue, and a method of forming such a rasp (10) are disclosed. The rasp (10) comprises a plate-like body (12) having opposite generally parallel major surface portions (14, 16), and may be detachably attached to a powered device for driving the rasp (10). A plurality of rasp portions (20) are arranged along the rasp (10) for substantially evenly rasping hard tissue. Each rasp portion (20) has a center (22), and a plurality of slots (24) through the body (12) extending generally radially outwardly from the center (22) of the portion (20) to define a plurality of cantilever cutting members (26A, 26B) extending generally radially inwardly of the rasp portion (20) generally toward the center (22) of the rasp portion (20) and separated from one another by the slots (24). The cutting members (26A, 26B) are bent to project outwardly from the major surface portions (14, 16) of the body (12) with alternating members (26A or 26B) of each rasp portion (20) being bent to project outwardly from alternating major surface portions (14 or 16) of the body (12).

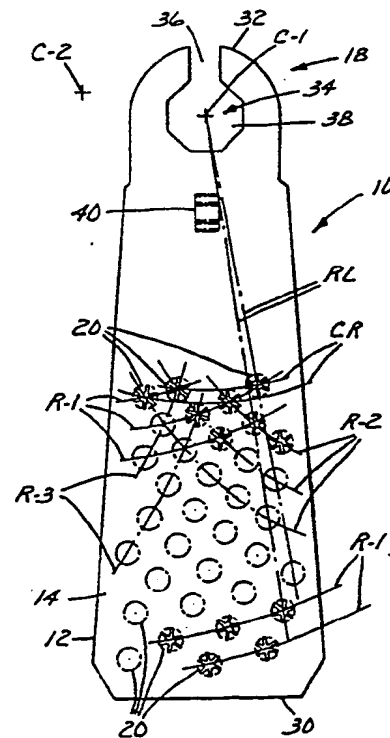


Fig. 1

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## BONE RASP

The invention relates generally to rasps, and more particularly to a rasp adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue.

### Background of the Invention

Orthopedic surgeons frequently desire smoother cut surfaces than they have been able to consistently obtain by sawing a section of bone, e.g., for secure engagement with a suitable prosthesis. Sometimes surgeons attempt to smooth out a freshly cut surface by running the side of the saw blade along the surface, possibly leading to bone necrosis (i.e., bone cell death) due to overheating if the saw is run too long. However, if the surgeon does not obtain a sufficiently smooth surface the time required for the patient's recovery may be increased, the strength of a bond between the bone and a prosthesis may be impaired, and the reliability of the prosthesis may even be jeopardized. If the surface is so uneven that substantial portions of the bone remain unloaded, the unloaded portion of the bone may resorb or dissolve into the body, causing further weakening of the bone and the bond between the bone and prosthesis.

### Summary of the Invention

The invention provides a rasp adapted for substantially evenly rasping generally hard tissue, such as bone, cartilage and associated tissue to obtain a smooth surface to, for example, enhance bonding with a prosthesis, and a method of manufacturing such a rasp. The rasp is designed to be readily attached to and detached from a powered surgical device, and is designed to avoid clogging of the cutting surfaces of the rasp by the tissue.

Generally, the rasp of the invention comprises a generally plate-like body having opposite generally parallel major surface portions, and attaching means on the body for detachably attaching the rasp to a powered device for driving the rasp. A plurality of rasp portions are arranged along the rasp for substantially evenly rasping hard tissue. Each rasp portion has a center, and a plurality of slots through the body extending generally radially outwardly from the center of the portion to define a plurality of cantilever cutting members extending generally radially inwardly of the rasp portion generally toward the center of the rasp portion and separated from one another by the slots. The cut-

ting members are bent to project outwardly from the major surface portions of the body, with alternating members of each rasp portion being bent to project outwardly from alternating major surface portions of the body.

The method of manufacturing the rasp includes the steps of providing a hardened stainless steel plate having opposite generally parallel major surfaces, and forming means on the plate for detachably attaching the rasp to a powered device for driving the rasp. A plurality of rasp portions are arranged along the rasp for substantially evenly rasping hard tissue. Each rasp portion is formed by laser cutting a plurality of slots through the plate to extend generally radially outwardly from a center to a perimeter to define a plurality of cantilever cutting members extending radially inwardly of the rasp portion, and bending the cutting members to project outwardly from the major surfaces of the plate with alternating members of the rasp portion being bent outwardly from alternating respective major surfaces of the plate.

Other features will be in part apparent and in part pointed out hereinafter.

### Brief Description of the Drawing

The invention will be further described with reference to the drawing wherein corresponding reference characters indicate corresponding parts throughout the several views of the drawing, and wherein:

Fig. 1 is a top plan view of a rasp of the invention, illustrating a preferred arrangement of rasp portions along the rasp;

Fig. 2 is an enlarged fragmentary top plan view of one of the rasp portions of Fig. 1; and

Fig. 3 is a cross-sectional view substantially along line 3-3 of Fig. 2.

### Detailed Description

As shown in Fig. 1, a rasp of the invention is designated in its entirety by the reference numeral 10. The rasp 10 is adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue. The rasp 10 is designed to be attached to a source of oscillating-pivoting motion via some type of releasable attaching mechanism (not shown), such as the attaching assembly for an osteotomy saw blade disclosed in coassigned U.S. Pat. No. 4,386,609, or the quick release mechanism for surgical devices disclosed in coassigned U.S. Pat. No.

3,943,934. As used herein, "rasp" refers to a rasp blade, body or generally plate-like structure, and is not intended to be limited to such a rasp blade, body or plate-like structure in combination with a power source, or the mechanism for attaching the rasp to the power source.

The rasp 10 generally comprises an elongate generally plate-like body 12 of hardened stainless steel, such as 301/302 SST full hard stainless steel. As used herein, "plate-like" refers to the substantially flat surfaces of the body 12, and does not require a circular outline. The body 12 has opposite generally parallel major surface portions or sides 14 and 16, and a thickness between the surfaces 14 and 16 of, for example, approximately 1mm (0.04 in.). Means 18 is provided on the body 12 for detachably attaching the rasp 10 to a powered device (not shown) for driving the rasp 10, for example, via one of the attaching assemblies discussed above. A plurality of rasp portions 20 are suitably arranged along the rasp 10 for substantially evenly rasping hard tissue.

As shown in Fig. 2, each rasp portion 20 has an open center 22, and a plurality of slots 24 through the body 12 extending generally radially outwardly from the center 22 of the portion 20. The slots 24 define a plurality (e.g., 6) of cantilever cutting members 26A, 26B extending generally radially inwardly of the rasp portion 20 generally toward the center 22 of the rasp portion 20. The cutting members 26A, 26B are separated from one another by the slots 24. The cutting members 26A, 26B are bent to project outwardly from the major surface portions 14 and 16 of the body 12, with alternating members 26A or 26B of each rasp portion 20 being bent to project outwardly from alternating respective major surface portions 14 or 16 of the body 12 so that either surface portion 14 or 16 may be used for rasping. That is, the three cutting members designated 26A are bent to project outwardly of respective surface portion 14 (upwardly in Fig. 3), and the three cutting members designated 26B are bent to project outwardly of respective surface portion 16 (downwardly in Fig. 3).

The center 22 and slots 24 of each rasp portion 20 are preferably laser-cut through the body by a carbon-dioxide laser, such as the laser sold under the trade designation "Trumatic 180 type 93031" by Trumpf G.m.b.H. & Co. of Ditzingen, West Germany, or the "Model VA15" laser sold by Lumonics Material Processing Corp. of Eden Prairie, Minnesota. Each slot 24 is cut to have a width W (Fig. 2) sufficiently great to permit rasped tissue to flow through the slots 24 during rasping (e.g., a width W of approximately 0.1-1mm, preferably 0.2mm, separating adjacent cutting members).

Each cutting member 26A, 26B is generally

triangular (Fig. 2), and has a free cutting point 28A or 28B spaced approximately 0.2-2mm (preferably 0.3-0.7mm) from the respective major surface portion 14 or 16 of the body 12. The perimeter of each rasp portion 20 is generally hexagonal, as defined by the attached bases of the six cutting members 26A, 26B. Each cutting member 26A, 26B extends generally radially inwardly from a respective side of the hexagonal perimeter toward the center 22 of the rasp portion 20. The cutting members 26A, 26B are bent outwardly from the major surface portions 14 and 16 of the body 12 at an angle A (Fig. 3) of approximately 10-45 degrees (preferably 20-25 degrees) with respect to the respective major surface portion 14 or 16, and each cutting member 26A, 26B has a length L of approximately 2-4mm (e.g., 2.4mm) between the free cutting point 28A or 28B and the perimeter of the rasp portion 20. The free cutting points 28A, 28B of the members 26A and 26B of each rasp portion 20 approximately define surface points along an imaginary cylinder having a diameter of approximately 0.1-3mm (e.g., 0.8mm), and a central longitudinal axis AX-1 generally perpendicular to the major surface portions 14 and 16 of the body 12.

As shown in Fig. 1, the rasp portions 20 are arranged in a pattern wherein there is increasing spacing between the rasp portions 20 in the direction away from the center C-1 of the attaching means 18 (downwardly in Fig. 1), which is also the center of pivoting-oscillating motion when the rasp 10 is being used. For example, the rasp portions 20 may be arranged along substantially equally-spaced radial lines RL extending generally radially outwardly from the center C-1 of the attaching means 18 at approximately two degree intervals. Because the radial lines RL diverge from one another in the direction away from the center C-1 of the attaching means 18, the rasp portions 20 are spaced farther apart adjacent the outward end 30 (downward end in Fig. 1) of the rasp 10 than they are closer to the center C-1. Greater spacing of cutting surfaces (rasp portions) adjacent the outward end 30 facilitates even rasping of tissue, since the outward end 30 of the rasp 10 is the fastest moving part of the rasp during use.

More specifically, the rasp portions 20 are arranged along the radial lines RL in staggered arcuate rows R-1 (and preferably R-2 and R-3) extending obliquely with respect to the radial lines RL and with respect to the direction of oscillating motion. The rasp portions 20 of any row R-1, R-2, or R-3 are staggered with respect to the intended direction of motion of the rasp 10. For example, each row R-1 is staggered with respect to one of the series of circumferences CR about the center C-1 of the attaching means 18 that are arranged serially outwardly from the center C-1. The inter-

secting arcuate rows R-1, R-2, and R-3, along which the rasp portions 20 are arranged, are preferably substantially centered with respect to an axis or center offset from the center C-1 of the attaching means 18 (e.g., R-1 may be arcuate about a center C-2). Rows R-1 are preferably spaced farther apart in the direction toward the outward end 30 of the rasp 10.

The attaching means 18 may comprise a specially-configured inward end portion 32 (Fig. 1) of the body 12 opposite the outward end 30, similar to the end portion described in coassigned U.S. Pat. No. 4,386,609, although other types of attaching means are also contemplated. A through aperture 34 is formed between the major surface portions 14 and 16. The through aperture 34 includes a narrow aperture portion 36 defined by spaced parallel walls opening through the inward (upward in Fig. 1) end or edge of the body 12, and a larger aperture portion 38 spaced from the inward edge of the body 12 and defined by octagonally arranged walls, as illustrated in Fig. 1, but which could be defined by a circular wall. A projection 40 from one of the major surface portions, e.g., 14, may be provided generally adjacent the through aperture 34 centrally of the width of the body 12 and between the aperture 34 and the rasp portions 20.

As various changes could be made in the above constructions and methods without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing be interpreted as illustrative and not in a limiting sense.

## Claims

1. A rasp (10) adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue, the rasp (10) comprising a generally plate-like body (12) having opposite generally parallel major surface portions (14,16), attaching means (18) on the body (12) for detachably attaching the rasp (10) to a powered device for driving the rasp (10), and a plurality of rasp portions (20) arranged along the rasp (10) for substantially evenly rasping hard tissue, each rasp portion (20) having a center (22), and a plurality of slots (24) through the body (12) extending generally radially outwardly from the center (22) of the portion (20) to define a plurality of cantilever cutting members (26A, 26B) extending generally radially inwardly of the rasp portion (20) generally toward the center (22) of the rasp portion (20) and separated from one another by the slots (24), the cutting members (26A, 26B) being bent to project outwardly from the major surface portions (14, 16) of the body (12) with alternating members

(26A or 26B) of each rasp portion (20) being bent to project outwardly from opposite surface portions (14 or 16) of the body (12).

2. A rasp (10) according to claim 1 wherein the slots (24) have a width sufficiently great to permit rasped tissue to flow through the slots (24) during rasping, the center (22) and slots (24) of each rasp portion (20) being laser-cut through the body (12).

3. A rasp (10) according to claim 2 wherein each cutting member (26A, 26B) is generally triangular, and has a free cutting point (28A or 28B) spaced approximately 0.2-2mm from a respective major surface portion (14 or 16) of the body (12), the cutting members (26A, 26B) being bent outwardly from a respective major surface portion (14 or 16) of the body (12) at an angle of approximately 10-45 degrees with respect to the major surface portions (14, 16) of the body (12).

4. A rasp (10) according to claim 1 wherein the attaching means (18) is adapted for detachably attaching the rasp (10) to a source of oscillating motion, the rasp portions (20) being arranged along substantially equally-spaced radial lines (RL) extending generally radially outwardly from the center (C-1) of the attaching means (18) so that the rasp portions (20) are arranged along substantially equally-spaced lines (RL) extending generally radially outwardly from the center (C-1) of oscillating motion when the rasp (10) is oscillating, the rasp portions (20) being arranged along the radial lines (RL) in staggered rows (R-1) extending obliquely with respect to the radial lines (RL) and with respect to the direction of oscillating motion.

5. A rasp according to claim 4 wherein the rasp portions are also arranged along arcs (R-1, R-2 or R-3) centered with respect to an axis (C-2) offset from the attaching means (18).

6. A method of manufacturing a rasp (10) adapted for rasping generally hard tissue, such as bone, cartilage and associated tissue, the method comprising the following steps:

providing a hardened stainless steel plate (12) having opposite generally parallel major surfaces (14, 16);

forming attaching means (18) on the plate (12) for detachably attaching the rasp (10) to a powered device for driving the rasp (10); and

forming a plurality of rasp portions (20) arranged along the rasp (10) for substantially evenly rasping hard tissue, including the steps of forming each rasp portion (20) by:

laser cutting a plurality of slots (24) through the plate (12) to extend generally radially outwardly from a center (22) to a perimeter to define a plurality of cantilever cutting members (26A, 26B) extending radially inwardly of the rasp portion (20); and

bending the cutting members (26A, 26B) to project

outwardly from the major surfaces (14, 16) of the plate (12) with alternating members (26A or 26B) of the rasp portion (20) being bent outwardly from alternating respective major surfaces (14 or 16) of the plate (12).

7. A method according to claim 6 wherein the step of laser-cutting a plurality of slots (24) includes laser-cutting the slots (24) to have a width of approximately 0.1-1mm separating adjacent cutting members (26A and 26B) and to define the cutting members (26A, 26B) as generally triangular and having a free cutting point (28A or 28B), and the step of bending the cutting members (26A, 26B) includes bending each cutting member (26A or 26B) such that its free cutting point (28A or 28B) is spaced approximately 0.2-2mm from its respective major surface (14 or 16) of the plate (12).

8. A method according to claim 7 wherein the step of laser-cutting a plurality of slots (24) includes cutting the slots (24) with a carbon dioxide laser to define six of the aforesaid cutting members (26A, 26B) in each rasp portion (20), with each cutting member (26A, 26B) having a length of approximately 2-4mm extending generally radially inwardly from a respective side of a hexagonal perimeter of the portion to the free cutting point (28A or 28B); the step of bending the cutting members (26A, 26B) including bending the members (26A, 26B) outwardly from the opposite major surfaces (14, 16) of the plate (12) at an angle of approximately 10-45 degrees with respect to the major surfaces (14, 16) of the plate (12), with the free cutting points (28A, 28B) of the members (26A, 26B) of each rasp portion (20) approximately defining surface points along a cylinder having a diameter of approximately 0.1-3mm and a central longitudinal axis (AX-1) generally perpendicular to the major surfaces (14, 16) of the plate (12).

9. A method according to claim 6 wherein the attaching means (18) is adapted for detachably attaching the rasp (10) to a source of oscillating motion, the step of forming rasp portions (20) including the step of arranging the rasp portions (20) substantially equally-spaced radial lines (RL) extending generally radially outwardly from the center (C-1) of the attaching means (18) so that the rasp portions (20) are arranged along substantially equally-spaced lines (RL) extending generally radially outwardly from the center (C-1) of oscillating motion when the rasp (20) is oscillating, the step of arranging the rasp portions (20) further including arranging the rasp portions (20) along the radial lines (RL) in staggered rows (R-1, R-2 and/or R-3) extending obliquely with respect to the radial lines (RL) and with respect to the direction of oscillating motion.

10. A method according to claim 9 wherein the step of arranging the rasp portions (20) further

includes arranging the rasp portions (20) along arcs (R-1, R-2 and/or R-3) centered with respect to an axis (C-2) offset from the attaching means (18).

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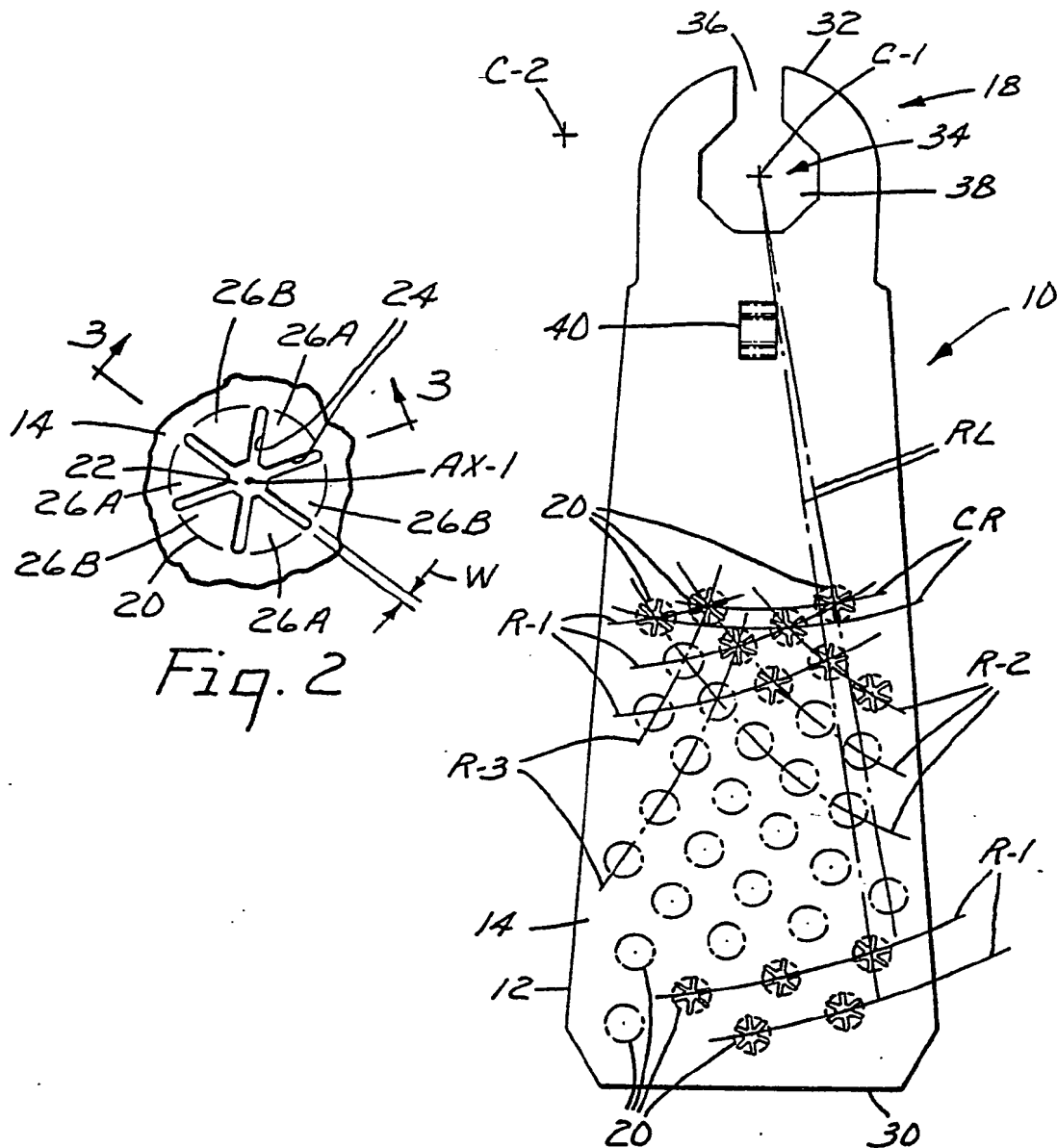


Fig. 2

Fig. 1

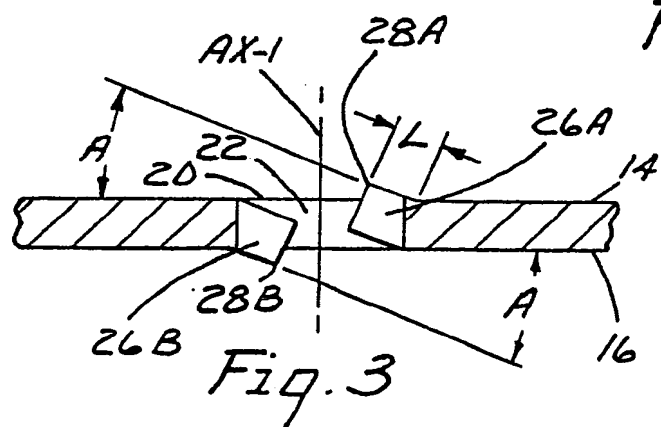


Fig. 3



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# EUROPEAN SEARCH REPORT

Application Number

EP 89 31 3549

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 5)
Y	MEDIZINISCH-ORTHOPÄDISCHE TECHNIK, vol. 108, no. 1, January/February 1988, pages 24-25, Stuttgart, DE; J. EICHLER: "Über eine Knochen-Raspel mit Motorantrieb" * Figure 2 *	1,4,5	A 61 B 17/16
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Y	GB-A- 836 051 (SIMMONDS AEROCESSORIES) * Page 2, lines 77-88; page 3, lines 9-24 *	1,4,5	
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A		3,7,9,10	TECHNICAL FIELDS SEARCHED (Int. Cl. 5)
A	US-A-3 151 347 (D.J. TINDALL) * Column 2, lines 18-20,35-40; figures 1-3 *	2,6	A 61 B B 23 D
A	WO-A-8 805 645 (G.J. ROGER) * Page 5, lines 4,5,24,25; figure 4 *	2	
A	MEDIZINISCH-ORTHOPÄDISCHE TECHNIK, vol. 104, no. 2, March-April 1984, page 48, Stuttgart, DE; J. EICHLER: "Über eine neue Raspel zur Bearbeitung von Knochenspongiosa" * The whole article *	1,2	
		-/-	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11-04-1990	Examiner WOLF C.H.S.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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# EUROPEAN SEARCH REPORT

Page 2

Application Number

EP 89 31 3549

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 033 398 (J.A.M. WOPEREIS) * Page 3, lines 10-25; page 4, line 15; figures *	1-3	
A	GB-A- 833 379 (RED DEVIL TOOLS) * Page 3, lines 81-92; figures 1,2 *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 11-04-1990	Examiner WOLF C.H.S.
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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